REMARKS/ARGUMENTS

The Pending Claims

The pending claims are directed to chemical-mechanical polishing compositions, as well as methods of polishing a substrate using the same. Claims 1-98 currently are pending. Reconsideration of the claims is respectfully requested in view of the remarks herein.

Discussion of the Claim Amendments

Independent claims 1, 21, 43, 64, 87, and 92 have been amended to recite the presence of about 1 to about 15 wt.% oxidizing agent. Dependent claims have been amended to be consistent with the amendment of the independent claims and to avoid duplication. Support for the claim amendments can be found in the present specification at paragraph 20. No new matter has been introduced by any of these amendments.

Summary of the Office Action

The Office Action rejects claims 1-98 under 35 U.S.C. § 103(a) as allegedly unpatentable over U.S. Patent 6,468,913 (Pasqualoni et al.) (hereinafter "the Pasqualoni '913 patent").

The Office Action also rejects claims 1-6, 11-18, 43, and 54-61 under 35 U.S.C. § 103(a) as allegedly unpatentable over U.S. Patent 5,769,689 (Cossaboon et al.) (hereinafter "the Cossaboon '689 patent").

Discussion of the Obviousness Rejection Based On Pasqualoni '931 Patent

All of the pending claims require, among other things, the use of (a) about 1 to about 15 wt.% oxidizing agent *and* (b) about 5×10^{-3} to about 10 mmoles/kg of calcium, barium and/or strontium.

The Pasqualoni '913 patent discloses a polishing slurry that comprises silica particles and hydrogen peroxide (col. 4, lines 18-20). The Pasqualoni '913 patent discloses that the

concentration of hydrogen peroxide generally is about 0.01 to about 10 wt.% and, when used with silica, about 0.03 to 4 wt.% (col. 4, lines 41-44). The Pasqualoni '913 patent discloses that "[o]ther suitable oxidizing agents may be utilized" and lists a variety of oxidizing agents including, *inter alia*, sodium hypochlorite, potassium hypochlorite, calcium hypochlorite, magnesium hypochlorite, and mixtures thereof (col. 4, lines 45-52). The Pasqualoni '913 patent fails to disclose a specific source of calcium, barium, and/or strontium other than by way of the oxidizing agent calcium hypochlorite.

Thus, in order for one of ordinary skill in the art to get to the present invention, as defined by the pending claims, from the general disclosure of the Pasqualoni '913 patent, the ordinary artisan would have to:

(a) decide to use a mixture of oxidizing agents,

(b) select a first oxidizing agent to use in an amount of about 1 to about 15 wt.%,

(c) select a second oxidizing agent that is calcium hypochlorite from among the list of other suitable oxidizing agents, and

(d) decide to use only enough of the second oxidizing agent (calcium hypochlorite) to provide about 5×10^{-3} to about 10 mmoles/kg calcium, which equates to about 0.00007 to about 0.14 wt.% calcium hypochlorite.

The Pasqualoni '913 patent, however, does not contain anything that would direct one of ordinary skill in the art to make such choices so as to arrive at the present invention. Indeed, if anything, the Pasqualoni '913 patent would lead one of ordinary skill in the art away from the claimed invention. In particular, the Pasqualoni '913 patent:

(a) emphasizes the use of hydrogen peroxide rather than a mixture of oxidizing agents,

(b) discloses the use of 0.01 to 10 wt.% hydrogen peroxide rather than at least 1 wt.% hydrogen peroxide as recited in the pending claims,

(c) does not focus attention on calcium hypochlorite as compared to any of the other suitable oxidizing agents (such as magnesium hypochlorite, which also would provide an alkaline earth metal but does not provide the benefits attendant the use of calcium in the context of the present invention), and

(d) does not disclose nor suggest the use of a relatively small concentration of the calcium hypochlorite in combination with the much larger concentration of another oxidizing agent such as hydrogen peroxide (rather the Pasqualoni '913 patent does not even refer to the relative amounts of oxidizing agents in a mixture of oxidizing agents).

The Pasqualoni '913 patent also discloses that the polishing slurry can contain a fluorine-containing compound that can be, among many other things, an alkaline earth metal fluoride salt (col. 5, lines 34-42). The Pasqualoni '913 patent discloses that the fluorine-containing compound may be present in the polishing slurry at a concentration of about 0.1 to about 1 wt.% (col. 5, lines 43-49). However, the Pasqualoni '913 patent does not teach nor suggest (a) the selection of an alkaline earth metal fluoride salt as opposed to any other listed fluorine-containing compounds (indeed, the Pasqualoni '913 patent explicitly states that the preferred fluorine-containing compound is ammonium fluoride), (b) the selection of calcium, barium, or strontium as the alkaline earth metal in an alkaline earth metal fluoride salt, or (c) the selection of a concentration range necessary to provide about 5×10^{-3} to about 10 mmoles/kg calcium, barium, or strontium, which equates, for example, to about 0.00004 to about 0.08 wt.% calcium fluoride (whereas the Pasqualoni '913 patent discloses the use of at least about 0.1 wt.% of the fluorine-containing compound).

It is abundantly clear that the Pasqualoni '913 patent would not have disclosed or suggested the present invention, as defined by the pending claims, to one of ordinary skill in the art. Indeed, the only way that the disclosure of the Pasqualoni '913 patent can be considered as teaching or suggesting the present invention as defined by the pending claims is through the use of hindsight, i.e., with the knowledge of the present application and the invention as claimed therein. It is impermissible for the Patent Office to engage in hindsight reconstruction of the claimed invention by using Applicants' invention as a template and selecting and combining elements from references to fill in that template. See *In re Gorman*, 933 F.2d 982, 18 U.S.P.Q.2d 1885 (Fed. Cir. 1991).

Furthermore, even assuming *arguendo* that the invention defined by the pending claims is *prima facie* obvious over the Pasqualoni '913 patent, which it is not, the examples set forth in the present specification clearly demonstrate that the invention defined by the pending claims achieves an unexpected result. As noted above, the Pasqualoni '913 patent provides that oxidizing agents suitable for use in the disclosed polishing slurries include, *inter alia*, sodium hypochlorite, potassium hypochlorite, calcium hypochlorite, and magnesium hypochlorite. Applicants unexpectedly found that polishing compositions comprising fumed silica, 3 wt.% hydrogen peroxide, and salts of calcium, barium, and strontium *but not magnesium*, which is another alkaline earth metal, provide for enhanced removal rates in the polishing of tantalum-containing substrates. Example 1 of the present application compares the removal rates observed for several polishing compositions comprising fumed silica and several metal salts when used to polish a substrate comprising tantalum. In particular, a polishing composition containing 0.50 mmoles/kg of calcium exhibited a tantalum removal rate of 608 Å/min, whereas a polishing composition containing 0.82 mmoles/kg of magnesium exhibited a tantalum removal rate of only 113 Å/min. Polishing compositions comprising other metals including aluminum, titanium, zirconium, and iron similarly failed to enhance the tantalum removal rate. Further, Example 4 of the present application illustrates the removal rates observed for polishing compositions containing fumed silica, 3 wt.% hydrogen peroxide, and salts of calcium, barium, or strontium as well as a control polishing composition not containing appreciable amounts of the same. The removal rates observed for polishing compositions containing calcium, barium, or strontium are all at least 6.4 times the removal rate observed for the control polishing composition. Thus, the results set forth in Examples 1 and 4 demonstrate the unexpected properties of polishing compositions containing calcium, barium, and strontium as compared to similar polishing compositions containing magnesium or no alkaline earth metal.

As a result, the present invention is not obvious in view of the Pasqualoni '913 patent. The obviousness rejection of the pending claims based on the Pasqualoni '913 patent should be withdrawn.

Discussion of the Obviousness Rejection Based On Cossaboon '689 Patent

The Office Action rejects claims 1-6, 11-18, 43, and 54-61 as allegedly unpatentable over the Cossaboon '689 patent. The Cossaboon '689 patent relates to a polishing slurry comprising a silica dispersion, a water-soluble salt, and an amine. When the water-soluble salt comprises a divalent cation, e.g., barium nitrate, the Cossaboon '689 patent discloses that the water-soluble salt can be present in a concentration of about 0.05 wt.%.

While barium nitrate is arguably an oxidizing agent, nothing in the Cossaboon '689 patent teaches or suggests that the disclosed polishing slurry comprises (a) about 1 to about 15 wt.% of an oxidizing agent *and* (b) about 5×10^{-3} to about 10 mmoles/kg of calcium, barium, and/or strontium, as recited in the rejected claims.

Even assuming that barium nitrate plays a dual role as barium source and oxidizing agent, the Cossaboon '689 patent teaches that the disclosed polishing slurry comprises about 0.05 wt.% barium nitrate, less than about one-twentieth of the lower limit for the amount of oxidizing agent (i.e., about 1 wt.%) required by the pending claims. Furthermore, if, for some reason, the amount of barium nitrate were increased to about 1 wt.%, then the amount of barium would be about 38 mmoles/kg, which is well in excess of the upper limit of the amount of barium (i.e., about 10 mmoles/kg) required by those pending claims that refer to the presence of barium.

Thus, the Cossaboon '689 patent fails to teach or suggest the present invention as defined by the pending claims. The obviousness rejection of claims 1-6, 11-18, 43, and 54-61 based on the Cossaboon '689 patent should be withdrawn.

Conclusion

Applicants respectfully submit that the patent application is in condition for allowance. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

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